SUPPLEMENTAL MATERIALS

Supplemental Materials A

We approximate the enzyme synthesis rate by using the following equation, assuming that the change of the two mer proteins in basal condition enters a steady state and is zero:

Basal steady state equations:

$$\frac{d[MerA_{basal}]}{dt} = B' - k_{deg}[MerA_{basal}]$$
$$\frac{d[MerB_{basal}]}{dt} = B - k_{deg}[MerB_{basal}]$$

B is defined as the basal synthesis rate and K_{deg} is designated as the degradation rate of the enzyme. because binary fission rate of the *E.coli* cells is significantly larger than the cytosolic enzyme degradation rate, we accounted the binary fission rate as the primary contributor for the **We use the equations to infer the basal enzymatic rate B**.

According to Leonhauser and colleague, the mer proteins are highly expressed in cell at basal rate. MerA accounted for approximately 3.9% out of the whole protein content in cell, while MerB accounted for approximately 2% out of the whole protein content in cell. In an appendix summary by Markarieva and colleagues, the average mass of *E.coli* is around 1.2 pg per cell. The volume of an average *E.coli* cell is approximately 1.1um^3, which is 1.1 fL. The mass of both MerA and MerB can be obtained from Leonhauser and colleagues to be 58711 Da (MerA) and 23078 Da (MerB).

Using the above information we can then calculate the basal steady state concentrations for MerA and MerB:

$$[MerA_{basal}] = \frac{600\,fg}{cell} * \frac{3.9\%}{100\%} * \frac{MerA}{58711\,Da} * \frac{cell}{1.1\,fL} = 3.6 * 10^{-4}\,M$$
$$[MerB_{basal}] = \frac{600\,fg}{cell} * \frac{2.0\%}{100\%} * \frac{MerB}{23078\,Da} * \frac{cell}{1.1\,fL} = 4.7 * 10^{-4}\,M$$

The induced steady state concentration for both MerA and MerB is described by the following equation:

Induced steady state equations:

$$\frac{d[MerA_{induced}]}{dt} = B' + \frac{V_a[Hg^{2+}]}{K'_m + [Hg^{2+}]} - k_{deg}[MerA_{induced}] = 0$$
$$\frac{d[MerB_{induced}]}{dt} = B + \frac{V_b[CH_3Hg+]}{K_m + [CH_3Hg+]} - k_{deg}[MerB_{induced}] = 0$$

The induced state concentrations are estimated through the paper published by Leonhauser and colleagues. The ratio of basal MerA concentration to induced MerA concentration is approximately 50:850, while the MerB concentration to induced MerB concentration is 40:600. Because the data is calculated on a relative scale, we need the basal concentration of the two mer proteins to calculate the

induced concentration of the two mer proteins:

$$[MerA] = Ratio'_{induced:basal} * [MerA_{basal}] = \frac{500}{60} * (3.6 * 10^{-4}\ M) = 3.0 * 10^{-3}\ M$$
$$[MerB] = Ratio_{induced:basal} * [MerB_{basal}] = \frac{600}{40} * (4.7 * 10^{-4}\ M) = 7.1 * 10^{-3}\ M$$

We use the enzyme reaction rate to approximate enzyme synthesis rate because we assume that the enzyme synthesis is the rate limiting step for the reaction rate.

Because at high methylmercury/ionic mercury concentration, the part of the equation represented by the reaction rate would be approximated by V_{max}, which corresponds to ɣ:

New Induced steady state equations:

$$\frac{d[MerA_{induced}]}{dt} = B' + V_a - k_{deg}[MerA_{induced}] = 0$$
$$\frac{d[MerB_{induced}]}{dt} = B + V_b - k_{deg}[MerB_{induced}] = 0$$

Therefore, we can obtain the reaction rates ($\gamma = V_{max}$) by using the above equations.

Supplemental Materials B

Regression Summary for $r = 9.957*[Hg^{2+}]/(2.78+[Hg^{2+}])$

Formula: y ~ f(x, a, b) x*a/(b+x)

Parameters:

	Estimate	Std. Error	t value	Pr(>|t|)
a	9.957	3.432	2.901	0.5441
b	2.780	1.453	1.225	0.2878

Residual standard error: 0.9515 on 4 degrees of freedom
Number of iterations to convergence: 25
Achieved convergence tolerance: 8.504e-06

References

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Mason, R. P., J. R. Reinfelder, and F. M. M. Morel. "Bioaccumulation of mercury and methylmercury." *Mercury as a Global Pollutant*. Springer Netherlands, 1995. 915-921.

Philippidis, George P, et al. "Kinetics of mercuric reduction in intact and permeabilized Escherichia coli cells." Enzyme and microbial technology 12.11 (1990):854-859.